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Research Article

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Effect of potassium and sulphur on yield and yield attributes of onion and chilli intercrops in a vertisol

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Summary

A field experiment was conducted during *Kharif* 2006 on a vertisol to study the effect of potassium and sulphur on yield and yield parameters of onion and chilli intercrops grown with four levels of potassium (0, 50, 75 and 100 kg K_2O ha^{-1}) and three levels of sulphur (0, 15 and 30 kg S ha^{-1}). Yield and yield attributes of onion and chilli increased with the individual application of 100 kg K_2O ha^{-1} and 30 kg S ha^{1}. The combined application of 100 K_2O and 30 kg S ha^{-1} recorded the maximum yield of both onion (19.52 t ha^{-1}) and chilli (3.90 q ha^{-1}) and also onion equivalent yield (23.42 t ha^{-1}) of the intercropping system.

Key words : Yield, Soil sodium, Soil potassium, Bulb, Vertisol, Intercrops

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Introduction

India is a leading country growing onion and chilli in the world. The productivity of both the crops is low as compared to other countries. The productivity and quality of both the crops can be enhanced by proper nutrient management. Potassium and sulphur are considered as quality elements as they improve quality parameters besides increasing the yield of many crops including chilli and onion. Farmers of transitional belt of Dharwad district (Zone 8) have found on their own that chilli plus onion is the most profitable cropping system but yields of both crops are far below their potential yield. Thus, the nutrition of potassium and sulphur play a significant role in increasing the yield of both onion and chilli intercrops. Keeping these things in view the present study was undertaken to study the effect of potassium and sulphur on yield and yield parameters of onion and chilli.

Resource and Research Methods

Field experiment was conducted during *Kharif* 2006 under rainfed condition in Main Agricultural Research Station (MARS), Dharwad. The soil of the experimental field was a vertisol with a pH of 7.54, EC (0.34 dSm^{-1}) organic carbon (5.80 g kg^{-1}), available nitrogen (303.80 kg ha^{-1}), available P (22.00 kg ha^{-1}), available K (401.00 kg ha^{-1}) and available sulphur (11.50 mg kg^{-1}). The experiment was laid out in Split Plot Design with four potassium levels (0, 50, 75 and 100 kg K_2O ha^{-1}) and three levels of sulphur (0, 15 and 30 kg S ha^{-1}) and onion cv. BELLARY RED AND CHILLI cv. BYADAGI DABBI were

test crops (intercrops). The recommended dose of 100 : 50 : 50 kg N, P_2O_5, K_2O ha^{-1} and sulphur as per treatments were supplied through factomphos a complex fertilizer (20 : 20 : 0 : 15 kg N, P_2O_5, K_2O and S) and remaining amount of N, P_2O_5 and K_2O were applied through urea, diammonium phosphate and muriate of potash, respectively. Shallow furrows at a distance of 15 cm were opened using a marker so as to maintain a row proportion of 4 : 1 (onion : chilli). Chillies were sown with a row spacing of 75 cm apart and in between the chilli rows, 4 rows of onion were sown with an interrow spacing of 15 cm. All the recommended cultural practices were followed. After complete development of bulbs, onion bulbs were harvested and only red ripe chilli fruits were picked. The yield and yield attributes of both onion and chilli were recorded. Onion equivalent yield (t ha^{-1}) was calculated by using the formula given by Reddy and Reddi (2002).

$$\text{Onion equivalent yield of chilli (t/ha)} = \frac{\text{Chilli yield (t/ha) x chilli price (Rs./t)}}{\text{Onion price(Rs./t)}}$$

$$\text{Onion equivalent yield (t/ha)} = \text{onion yield (t/ha)} + \text{onion equivalent yield of chilli (t/ha)}$$

Research Findings and Discussion

The results of the field experiment are given in Table 1, 2, 3 and 4. The different levels of potassium significantly increased the yield and yield components *viz.*, bulb diameter, bulb weight and bulb length over control. The treatment receiving potassium @ 100 kg K_2O ha^{-1} recorded the maximum bulb diameter (5.76 cm), bulb length (4.70 cm) and bulb weight (81.30 g $plant^{-1}$) compared to control (4.64 cm, 3.80 cm and 33.08 g $plant^{-1}$, respectively). The increase in yield could be attributed to positive correlation existed between yield and yield attributes.

Table 1 : Effect of potassium and sulphur on bulb diameter, bulb length, bulb weight and bulb yield of onion

Potassium levels	Sulphur levels															
	Bulb diameter (cm)				Bulb length (cm)				Bulb weight (g/plant)				Bulb yield (t/ha)			
	S_0	S_1	S_2	Mean	S_0	S_1	S_2	Mean	S_0	S_1	S_2	Mean	S_0	S_1	S_2	Mean
K_0	4.47	4.66	4.79	4.64	3.66	3.81	3.94	3.80	28.43	32.77	38.06	33.08	12.45	13.29	13.98	13.24
K_1	4.91	5.06	5.30	5.09	4.04	4.20	4.33	4.19	42.54	47.50	54.79	48.27	14.13	14.69	15.30	14.70
K_2	5.21	5.49	5.66	5.45	4.28	4.42	4.57	4.42	52.83	62.45	71.95	62.41	14.75	16.16	18.22	16.37
K_3	5.55	5.75	6.00	5.76	4.51	4.60	5.01	4.70	69.71	81.35	92.84	81.30	16.26	18.71	19.52	18.17
Mean	5.04	5.24	5.44	5.24	4.12	4.26	4.46	4.28	48.38	56.02	64.41	56.27	14.39	15.71	16.76	15.62
	S.E.±		C.D. (P=0.05)		S.E.±		C.D. (P=0.05)		S.E.±		C.D. (P=0.05)		S.E.±		C.D. (P=0.05)	
Potassium	0.10		0.31		0.07		0.24		2.32		8.02		0.35		1.06	
Sulphur	0.03		0.09		0.06		0.19		1.91		5.74		0.31		1.03	
Potassium x Sulphur	0.11		NS		0.12		NS		3.89		NS		0.71		NS	

K_0-No potassium, K_1-50 kg K_2O/ha, K_2- 75 kg K_2O / ha, K_3- 100 kg K_2O /ha, S_0 –No sulphur, S_1 -15 kg S /ha, S_2-30 kg S /ha, NS=Non-significant

Table 2 : Effect of potassium and sulphur on number of fruits per plant, fruit length and 100 fruit weight of chilli

Potassium levels	Sulphur levels											
	Number of fruits / plant				Fruit length (cm)				100 fruit weight (g)			
	S_0	S_1	S_2	Mean	S_0	S_1	S_2	Mean	S_0	S_1	S_2	Mean
K_0	9.96	10.83	12.81	11.20	6.95	7.24	9.21	8.13	37.58	39.44	41.12	39.38
K_1	14.89	17.54	19.23	17.22	9.29	10.20	11.14	10.21	42.57	44.96	47.98	45.17
K_2	18.09	21.83	26.28	22.06	10.34	12.06	14.16	12.18	46.81	49.51	53.93	50.08
K_3	24.31	28.97	32.13	28.47	13.01	15.56	16.91	15.16	51.70	56.17	59.10	55.65
Mean	16.81	19.80	22.61	19.74	9.90	11.52	12.86	11.42	44.67	47.52	50.53	47.57
	S.E.±		C.D. (P=0.05)		S.E.±		C.D. (P=0.05)		S.E.±		C.D. (P=0.05)	
Potassium	0.75		2.60		0.27		0.93		1.09		3.79	
Sulphur	0.94		2.8		0.38		1.13		1.36		4.1	
Potassium x Sulphur	1.7		NS		0.68		NS		2.48		NS	

K_0-No potassium, K_1-50 kg K_2O/ha, K_2- 75 kg K_2O / ha, K_3- 100 kg K_2O /ha, S_0 –No sulphur, S_1 -15 kg S /ha, S_2 -30 kg S /ha, NS =Non- significant

The highest yield (18.17 t ha^{-1}) was recorded with K_3 (100 kg K_2O ha^{-1}) which was 36.85 per cent increase over control (13.24 t ha^{-1}). The higher yields might be due to beneficial effects of potassium on growth parameters, which ultimately improved the yield of onion. Application of sulphur @ 30 kg ha^{-1} also recorded significantly higher bulb diameter (5.44 cm), length (4.46 cm) and bulb weight (64.41 g) compared to S_1 and S_0 levels.

A significantly higher yield of onion (16.76 t ha^{-1}) was observed with the application of S @ 30 kg ha^{-1} over S_2 15 kg ha^{-1} (15.71 t ha^{-1}) and control (14.39 t ha^{-1}). The increase in yield was about 17.02 per cent over control. The increase in bulb yield with application of higher levels of S might be due to increased uptake of N, P, K and S by the crop which might have enhanced the synthesis and translocation of photosynthates to the bulbs and storage organs of the onion. The present results are in agreement with the findings of Nagaich *et al*. (1998) and Salimath (1990) in onion.

In chilli crop, yield is the cumulative effect of yield components *viz.*, number of fruits $plant^{-1}$, fruit length and 100 fruit weight. Application of potassium significantly increased the number of fruits $plant^{-1}$, fruit length and 100 fruit weight compared to control.The maximum number of fruits $plant^{-1}$ (28.47), fruit length (15.16 cm) and 100 fruit weight (55.65 g) were observed with a application of 100 kg K_2O ha^{-1}. Similarly the same treatment recorded significantly higher dry fruit yield of chilli (3.43 q ha^{-1}) compared to control (2.30 q ha^{-1}). The increase in yield and yield components of chilli with different levels of potassium might be due to mobility of photosynthates from the source to sink. Similar findings were reported by Suresh (2000) and Ananthi *et al*. (2004).

Application of S @ 30 kg ha^{-1} recorded significantly higher number of fruits $plant^{-1}$ (22.61), fruits length (12.86 cm), 100 fruit weight (50.53 g) and dry fruit yield of chilli (3.30 q/ha) compared to 15 kg S ha^{-1} and control.

Table 3 : Effect of potassium and sulphur on dry fruit yield (q/ha) of chilli

Potassium levels	Sulphur levels			
	S_0	S_1	S_2	Mean
K_0	2.20	2.30	2.40	2.30
K_1	2.50	2.60	3.20	2.75
K_2	2.60	3.00	3.60	3.07
K_3	3.10	3.30	3.90	3.43
Mean	2.60	2.80	3.30	2.90
	S.E.±		C.D. (P=0.05)	
Potassium	0.03		0.12	
Sulphur	0.06		0.2	
Potassium x sulphur	0.11		NS	

K_0 : No potassium , K_1 : 50 kg K_2O / ha, K_2 : 75 kg K_2O / ha, K_3 : 100 kg K_2O / ha, S_0 : No sulphur, S_1 : 15 kg S / ha, S_2 :30 kg S / ha, NS=Non -significant

Table 4 : Effect of potassium and sulphur on onion equivalent yield (t/ha) of onion and chilli grown as intercrops

Potassium levels	Sulphur levels			
	S_0	S_1	S_2	Mean
K_0	14.75	15.69	16.38	15.60
K_1	16.63	17.29	18.83	17.58
K_2	17.35	19.16	21.82	19.44
K_3	19.36	22.01	23.42	21.59
Mean	17.02	18.54	20.11	18.55
	S.E.±		C.D. (P=0.05)	
Potassium	0.35		1.2	
Sulphur	0.54		1.42	
Potassium x sulphur	0.95		NS	

K_0 : No potassium, K_1 : 50 kg K_2O/ha, K_2 : 75 kg K_2O/ha, K_3 : 100 kg K_2O/ha, S_0 : No sulphur, S_1 : 15 kg S/ha, S_2 : 30 kg S/ha, NS= Non-significant

This increase in yield and yield components with increase in sulphur application might be due to the higher growth and leaf chlorophyll content coupled with higher nutrient uptake leading to greater synthesis and translocation of photosynthates to fruits. These results corroborate the findings of Niranjana (1988) and Thakre *et al*. (2005). A combined application of 100 kg K_2O plus 30 kg S ha^{-1} recorded higher yield of both onion (19.52 t ha^{-1}) and chilli (3.90 q ha^{-1}).

Onion equivalent yield of intercrops was also ficantly influenced by the application of different levels of K and S. A significantly higher onion equivalent yield of 21.59 and 20.11 t ha^{-1} was noticed with application of 100 kg K_2O and 30 kg S ha^{-1}, respectively over control. The interaction effects of K and S on onion equivalent yield was also non significant. However, the treatment combination of 100 kg K_2O plus 30 kg S ha^{-1} recorded maximum onion equivalent yield (23.42 t ha^{-1}) over K_0S_0 (14.75 t ha^{-1}).

Based on the results obtained, it may be concluded, the combined application of 100 kg K_2O plus 30 kg S ha^{-1} is better for getting the highest yield of onion and chilli and onion equivalent yield of intercrops. Pongde and Ghodpade (2014) on maize, Bodkhe and Ismail (2014) and Ismail *et al*. (2013) on soybean also worked on the related topic of vertisol and the results found were more or less similar to the present investigation.

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